Patent Claims

1. A device for the desynchronization of activity of brain areas comprising means for stimulating the brain regions, characterized in that it comprises the following components:

N electrodes (2) where $N \geq 2$; and

control means which so controls at least two of the electrodes in at least two subpopulations of a neuron population to be desynchronized so that a phase resetting or reversal of the neuronal activity is effected.

2. The device according to claim 1, characterized in that

the control so regulates each of at least a part of the N electrodes (2) so that the neuron population to be desynchronized is either directly stimulated and/or

a neuron population is stimulated which is connected to the neuron population to be desynchronized by a nerve fiber bundle.

3. The device according to claim 1 or claim 2, characterized in that it comprises a control (4) which controls at least two electrodes (2) with signals for individual stimuli.

4. The device according to claim 3, characterized in that the control (4) generates an individual stimulus which is at least a component from the group of individual pulses, a high frequency pulse train, and a low frequency pulse train.

5. The device according to claim 4, characterized in that the control (4) generates high frequency pulse trains and low frequency pulse trains which are composed of individual pulses.

6. The device according to one of claims 4 or 5, characterized in that the control produces an individual pulses which is at least a component of the group of positive monophasic individual pulses, negative monophasic individual pulses, and biphasic individual pulses.

7. The device according to claim 6, characterized in that the control produces biphasic individual pulses which are combinations of positive and negative monophasic individual pulses whose net energy input is substantially zero.

8. The device according to one of claims 4 to 7, characterized in that the control (4) produces high frequency pulse trains and/or low frequency pulse trains whereby the individual pulses used within a pulse train are of different amplitude and/or type and/or duration and/or different lateral spacing.

9. The device according to one of claims 4 to 8, characterized in that the control (4) produces high frequency pulse trains and/or low frequency pulse trains whereby within a pulse train the individual pulses used are identical.

10. The device according to one of claims 3 to 8, characterized in that the control (4) produces a high frequency pulse train and/or a low frequency pulse train whereby within a pulse train the individual pulses used vary stochastically and/or deterministically as to the amplitude and/or the type and/or the duration and/or the time spacing.

11. The device according to one of claims 4 to 10, characterized in that the control (4) is so programmed that within a high frequency pulse train or a low frequency pulse train the individual pulses are applied with periodically or at stochastically and/or deterministically varying points in time.

12. The device according to one of claims 3 to 11, characterized in that the control (4) can vary the type and/or the energy input and/or the polarity of the individual stimuli.

13. The device according to one of claims 1 to 12, characterized in that the control (4) outputs to N electrodes (2) at least partly at different points in time.

14. The device according to claim 13, characterized in that the control (4) energizes all N electrodes (2)at different points in time.

15. The device according to one of claims 13 or 14, characterized in that the control (4) outputs signals to all N electrodes (2) at least partly at substantially equidistant points in time.

16. The device according to one of claims 1 to 15, characterized in that the control (4) is so programmed that it detects differences in the transit time between the excitation site of an individual electrode(2) and the site of the neuron population stimulated thereby.

17. The device according to claim 17, characterized in that the control (4) is so programmed that in calculating the point in time for the individual stimulation at the individual electrodes, the associated transit times are calculated.

18. The device according to one of claims 3 to 17, characterized in that the control (4) outputs signals for the complete stimulation to the electrodes (2)which are made up of individual excitations.

19. The device according to one of [sic.] claim 18, characterized in that the control (4) in the framework of the complete stimulation outputs respective individual excitation pulses to each of two electrodes (2) of N electrodes (2).

20. The device according to one of claims 18 or 19, characterized in that the control (4) in the framework of a complete stimulation outputs respective individual excitation pulses to all of the electrodes (2).

21. The device according to one of claims 18 - 20 characterized in that the control (4) generates a total stimulation whose net energy input is substantially 0.

22. The device according to one of claims 18 - 21 characterized in that the control (4) in the frame work of the application of a total stimulation signal, delivers to all N electrodes (2) signals at substantially equidistant time points.

23. The device according to one of claims 18 - 22 characterized in that the control (4) produces a sequence of the total stimulation with a deterministic and/or stochastic algorithm.

24. The device according to one of claims 18 - 23 characterized in that the control (4) determines and varies the sequence and/or the type and/or the intensity and/or the energy input of the individual stimuli in a total stimulation with a deterministic and/or stochastic algorithm.

25. The device according to one of claims 18 - 24 characterized in that the control (4) is so programmed that in the

frame work of a total stimulation, the stimuli applied to different electrodes (2) can be varied.

26. The device according to claim 25 characterized in that the control (4) is so programmed that in the frame work of a total stimulation the electrodes (2) are controlled based upon stochastic and/or deterministic algorithm.

27. The device according to one of claims 1 - 26 characterized in that the electrodes (2) are at least partly of different lengths.

28. The device according to one of claims 1 - 27 characterized in that the control (4) is so programmed that it is not need or demand controlled.

29. The device according to one of claims 1 - 27 characterized in that the control (4) is so programmed that it is need or demand controlled.

30. The device according to claim 29 characterized in that the control (4) is so programmed that it is responsive to a feedback signal measured by the sensor (3).

31. The device according to claim 30 characterized in that the control (4) is so programmed that it uses the amplitude of the feedback signal measured by the sensor (3).

32. The device according to claim 31 characterized in that the control (4) estimates the amplitude of the feedback signal measured by sensor (3) in that it utilizes the feedback signal itself and/or the magnitude of the feedback signal and/or a feedback signal derived from band path filtering to obtain the pathology-specific frequency range and/or the magnitude of the band path filtered feed back signal in the pathology-specific frequency range and/or an instantaneous amplitude determined by Hilbert transformation or wavelet analysis after ban pass filtering.

33. The device according to one of claims 29 - 32 characterized in that the control (4) matches the stimulation period T to the instantaneous frequency of the neuron population to be desynchronized.

34. The device according to claim 33 characterized in that the control (4) determines the instantaneous frequency of the neuron population to be desynchronized either by an estimation of the time difference of trigger points or by means of frequency estimation.

35. The device according to one of claims 29 - 34 characterized in that the control (4) operates in accordance with a demand controlled timing.

36. The device according to claim 35 characterized in that the control (4) applies a total stimulation upon the detection of a pathological feature in the feedback signal measured by the sensor (3).

37. The device according to claim 36 characterized in that the control (4) detects a pathological feature in that it detects the overstepping of a threshold of the amplitude of the feedback signal measured by the sensor (3).

38. The device according to one of claims 35 - 37 characterized in that the control (4) detects a pathological feature in that it detects the overstepping of a threshold value of the amplitude measured by the sensor (3) of a feedback signal in a pathologically specific frequency range by band pass filtering of the feedback signal.

39. The device according to one of claims 37 or 38 characterized in that the control (4) compares the amplitude of the feedback signal measured by sensor (3) with the threshold value.

40. The device according to one of claims 36 to 39 characterized in that the control (4) compares the amplitude of the feedback signal measured by sensor (3) with the threshold value in a sliding time window for detection of a pathological feature.

41. The device according to one of claims 35 - 40 characterized in that the control (4) so regulates the stimulus strength on a time scale between 10 and 1000 of the feedback signal that the neuron population to be desynchronized is sufficiently desynchronized.

42. The device according to claim 41 characterized in that the control (4), for the purpose of controlling the stimulation strength, varies the amplitude of the individual pulse and/or the number of individual pulses and/or the rate and/or the duration of individual pulses in a high frequency or low frequency pulse train.

43. The device according to one of claims 29 - 34 characterized in that the control (4) operates with a demand control stimulation strength.

44. The device according to claim 43 characterized in that the control (4) to time t_j, generates a total stimulation whereby

$$t_{j+1} - t_j = N_j T + x_j$$

Formula 2

applies.

45. The device according to claim 44 characterized in that the control (4) generates the total stimulation to time t_j, whereby the count sequence represented by N_1, N_2, N_3 etc is either a constant count sequence or is generated in accordance with a stochastic and/or chaotic structure.

46. The device according to one of claims 43 - 45 characterized in that the control (4) is so programmed that it matches the strength of the individual total stimulation to the expression of the pathological feature and/or the amplitude of the feedback signal.

47. The device according to one of claims 43 - 46 characterized in that the control (4) is so programmed that the number M_j of the individual pulses which are applied by the electrodes (2) for each applied high frequency pulse train is given by

$$M_j = A_j \frac{M^{\max}}{A^{\max}} + M^{\min}$$

Formula 3.

48. The device according to one of claims 43 - 47 characterized in that the control (4) is so programmed that the relationship between stimulation and the expression of the pathological feature is either manually adjustable or controlled as a function of the stimulation effect automatically.

49. The device according to one of claims 47 or 48 characterized in that the control (4) is so programmed that the parameters of Formula 3

$$M_j = A_j \frac{M^{\max}}{A^{\max}} + M^{\min}$$

is so controlled on a time scale of 10 and 1000 periods of the feedback signal that the pathological feature is sufficiently suppressed.

50. A control characterized in that it is so programmed that it can carry out the steps for operating a device in accordance with one of claims 1 - 48.

51. The use of the device for the treatment of pathologies; parkinsonism, essential tremor, dystonie, obsessive disorders and epilepsy.

52. The use of the control for the treatment of pathologies; parkinsonism, essential tremor, dystonie, obsessive disorders and epilepsy.